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New Construction Peer Review

Getting the Most out of Your Building Envelope Consultant

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With today's strict energy conservation codes and increasingly complex facade and roof systems, many new construction projects involve the services of a building envelope design professional as part of the project team. Making the best use of that consultant's services is important not only to the bottom line of the construction project, but to the energy efficiency, code compliance, sustainability, integrity, and longevity of the building. When should a building envelope consultant get involved in a new construction project? What services should he or she be expected to provide? How does the consultant's role differ from that of the architect of record? What, exactly, does a building envelope consultant do?

Technical details, such as sealant joint design, make the difference between a long-lasting building and one that fails prematurely.

By working with the design team to establish performance criteria for the building envelope, the consultant proposes materials and components to optimize efficiency across facade and roof assemblies. The envelope specialist can identify ways to reduce costs with details that are watertight, thermally insulating, and correctly constructed; when amplified over the entire building, even small improvements can add up to substantial savings. Ideally, boosting exterior envelope performance can reduce the necessity for larger mechanical packages and mitigate the effect of energy-consuming systems, such as lighting.

To realize these benefits, there are steps a building owner or design architect can take to get the most value from a building envelope consultant. The role of the envelope specialist changes throughout the design and construction process, and knowing when and how he or she should be involved can make a big difference to the project outcome.

Material and Assembly Specification

Because building envelope architects and engineers work exclusively with the outsides of buildings, they tend to amass substantial knowledge of facade and roof systems and their properties. Therefore, when it comes time to formulate and apply building envelope system criteria – whether budgetary, ecological, performance, or design – the envelope specialist brings key background experience to the project team in establishing these parameters

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Curtain wall construction at this glass high-rise involved quality control of fabrication, assembly, installation, and field verification, to see that the final product meets design standards for performance and sustainability.

and identifying options for suitable envelope systems.

Recently, one of our engineers provided facade design consultation services for a new residential high-rise in Manhattan. In a city where space is at a premium, a central consideration for any developer is how to maximize interior floor space while meeting design and performance requirements for the facade. After evaluating energy code requirements and probable construction costs, the engineer was able to recommend a facade assembly that met the relevant energy efficiency requirements, but which was shallow in depth, thereby maximizing apartment square footage.

With energy code often the prime directive driving design, balancing mechanical package efficiency with building envelope thermal resistance has become a central consideration. In order to achieve the requisite energy performance, design teams must offset an economical mechanical package with strict control of heat transfer across the building exterior. Working with the mechanical engineer, the envelope consultant provides options that consider the impact of exterior envelope design on the size and cost of heating and cooling systems.

As an example, consider fenestration design. Energy loss tends to be greatest at the edges of glazing, where inefficiencies of the frame transfer thermal load to the glass. By specifying *warm edge spacers* – low-conductivity materials used in lieu of aluminum to position the panes of insulating glazing units (IGUs) – the envelope consultant can mitigate heat loss across windows or glazed curtain walls. Even seemingly minor modifications like this one can improve thermal performance enough to permit downsizing of mechanical equipment, often netting both short- and long-term savings.

Green building projects can make the most of the building envelope consultant by involving him or her in the design phase, to brainstorm exterior wall and roof assemblies and to act as a sounding board for design decisions. Many government projects are now required to obtain certification from Leadership in Energy and Environmental Design (LEED) or similar rating systems. At the same time, municipal, state, and federal budgets are stretched thin, and every dollar counts. That's where building envelope consultants really pay for themselves: by specifying components individually, rather than as a prefabricated system, the envelope specialist can handpick only those parts that are essential, thereby reducing costs on a piece-by-piece basis.

A recent new construction project at a military base in New England provides an excellent example of design collaboration between the architect of record and the envelope specialist. With a very tight budget, the project was nonetheless expected to earn LEED certification by using efficient, well-designed envelope systems. Our building envelope engineer ran thermal computer models for a number of different roof assemblies, then provided options to the project team. In addition, we advised on the integration of air and vapor barriers, particularly at facade/roof intersections. By optimizing the configuration and type of insulation in the roof assembly, we were able to assist the design architect in maximizing efficiency while reducing construction costs. The project stayed within budget and earned LEED Gold certification.

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The Building Envelope Consultant's Role

The purpose of an exterior envelope specialist in a new construction project is not to supplant the prime architect; rather, he or she complements the work of the designer by providing focused attention to calculations, technical details, codes, standards, and material properties and assemblies. For new construction projects, including expansions, additions, and adaptive reuse, the building envelope consultant's responsibilities include:

Maximize efficient use of materials and assemblies. Providing options for exterior envelope systems that meet performance objectives and budget requirements demands in-depth understanding of material properties and experience with proprietary systems. The building envelope consultant works with the designer and the structural and mechanical engineers to establish performance requirements, then identifies products and assemblies that are appropriate to the design and fulfill program objectives. Often, the envelope consultant is able to suggest assemblies that reduce costs, maximize sustainability, improve efficiency, or do all of the above.

Take care of technical details. Facade enclosure requirements have become so technical that meeting complex codes and standards can absorb enough of the architect's time that it impacts building design. The building envelope consultant is responsible for researching and applying the latest building codes and industry standards, and then advising the prime architect of the ways in which these stipulations impact design decisions.

Keep abreast of changing energy efficiency and green building requirements. Today's energy codes can be tough to pin down, varying not just over time, but also from city to city, from building to building, and even from one portion of a building to another. Determining the insulating value for the building envelope is often a balancing act between facade thermal resistance and mechanical system efficiency. The envelope consultant can evaluate cost and performance trade-offs and identify options that fulfill energy code requirements, maintain indoor comfort, and provide long-term value.

Act as the problem-solver. Envelope consultants tend to have extensive experience reverse-engineering building exterior failures, which enables them to foresee potential problems and sidestep them. During construction, the envelope specialist adds a level of quality control, verifying that key details are followed so as to maintain energy efficiency and weather integrity, and see that sustainability is not compromised. The building envelope consultant responds to unexpected technical questions and constructability issues to see that problems are resolved cost-effectively and in keeping with the design intent.

Make sure the building envelope reflects the designer's vision – and still works. Through document review, mockups, field verification, and testing, the building envelope specialist is there to focus on the technicalities of installation and real-world performance, to see that the building envelope fulfills intended energy and sustainability objectives. The envelope consultant can make subtle changes to construction details that address technical, logistical, or practical considerations, without compromising the design aesthetic.

The building envelope consultant is best engaged early in the design/construction process, before conceptual designs are translated into technical documents or become tangible reality in the field. Although an envelope specialist does provide important services during construction, bringing the building envelope consultant on board during the design phase can be instrumental in preventing construction delays and change orders that can add to project costs. ■

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Codes, Standards, Rules, and Best Practices

With the current trend toward increasingly stringent energy codes and the push by organizations like the American Institute of Architects toward sustainable design and green building, the requirements for facade and roof performance are a moving target. Add to that changes to state and local building codes and constantly evolving green building certification requirements, and the design of even seemingly straightforward envelope elements becomes anything but simple.

To keep up with these tumultuous changes, a design architect would have to spend a considerable amount of time on each project researching current codes and scouring industry literature for small details like air barrier terminations or sealant composition. Fortunately, the building envelope consultant is well positioned to do just that. With building exterior details as their focal point, envelope consultants can afford to devote the time and attention it takes to stay abreast of current regulations and keep up with the latest developments in facade and roof systems.

Cool roof technology is one example of an area in which building envelope consultants are particularly important to the success of the project. As reflective and vegetated roofs become increasingly popular, architects are faced with the challenge of selecting, specifying, and detailing a system that meets performance requirements, falls within the available budget, and is suited to the building structure, climate, and location. Well-versed in the pros and cons of various waterproofing systems and roof membranes, the building envelope consultant can provide recommendations for a roof assembly that meets design objectives.

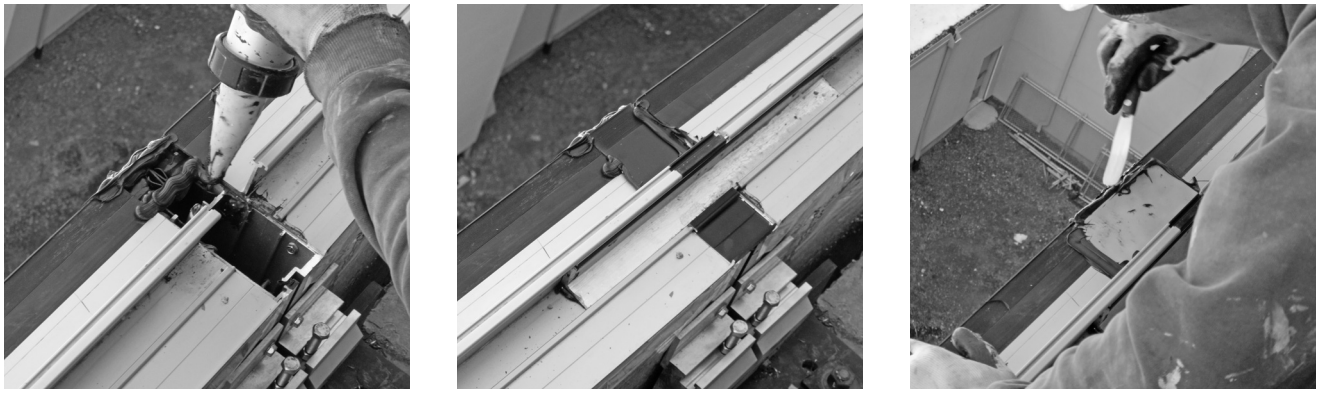
For reflective roofs, the envelope specialist can assist the owner and architect in deciding whether, for instance, a single-ply white sheet system or a modified bitumen assembly with reflective granular cap sheet would better meet stated performance objectives. Roofs used as public space raise still more questions, such as whether recessed terrace lighting might generate too much heat too close to insulation, or whether transformers can be exposed to the elements.

Vegetated roofs demand strict attention to waterproofing details, given that removing layers of plant matter and growing medium to search for a leak is labor-intensive and expensive. Getting the envelope consultant involved in specifying a resilient waterproofing system can provide owners with the reassurance that their lush green-roof amenity won't turn into a leak-ridden liability.

Constructability Review

It's not uncommon for construction documents to be what one of our engineers calls "light on details." Because roof and facade assemblies are often proprietary systems, designers tend to rely on manufacturers' standard details. In the field, however, components don't always work together as smoothly as they do on paper, with intersecting building areas and irregular dimensions that defy boilerplate drawings. These discrepancies can lead to change orders and delays as the project team scrambles to respond to nonstandard or unforeseen conditions.

Pre-construction, the building envelope consultant reviews drawings and specifications to evaluate or provide details, particularly at intersections, terminations, penetrations, and changes from one material to another. The envelope specialist redlines drawings and provides technical information, raising questions about the finer points of edge flashing, membrane tie-ins, fasteners, construction sequencing, and other information that may be missing from or unclear in the design.



Curtain wall installation review: Creating a water-tight intersection is a multi-step process, beginning with application of sealant at the glazing pocket *(left)*, then placement of metal covering over the gap *(center)*, followed by appropriate tooling of sealant at the horizontal weather seal *(right)*.

Waterproofing installation review: As potential sources of water infiltration, thresholds demand attention to detail. Here, asphalt and roofing felt *(left)* are applied under the flashing membrane *(center)* to create a positive lap, then the roofing base membrane is embedded into the asphalt *(right)*.

Some details might seem to work on paper, but would be difficult to construct in practice. While reviewing plans for a new addition to a Washington DC business school, our architects identified roof drain details that could be simplified, not only shortening construction time, but also improving the longevity and functionality of the roof assembly. Details that might otherwise have been left to the contractor, such as attachment methods for copings and edge protection at changes in roof height, were addressed in advance, saving time in the field and improving construction outcomes.

Problem Solving

During the contract documents phase, the building envelope consultant's role shifts from providing options to preventing errors. Early in the design process, the envelope consultant looks at broad considerations of energy performance, code compliance, structural integrity, sustainability, and cost. Once the project team and the owner agree to move forward with a design, the consultant turns his or her attention to construction details.

Not long ago, an urban university added a glass-enclosed student center in an infill area between two historic academic halls. Elegant in its simplicity and innovative in the use of a dynamic facade, the building was featured in a number of architectural publications and was the recipient of a design award. Unfortunately, from nearly the day construction was complete, the building leaked.

Primarily, the flaw lay with the gutter system, the design of which had the unintended effect of channeling water toward the building, rather than away. As a result, the university spent additional time and money on the redesign and reconstruction of the entire roof drainage and gutter system. Involving an envelope consultant to evaluate facade/roof intersections and other key integration points might have prevented the failure, by correcting potential trouble spots before the project ever went into construction.

Working backward to determine the source of a problem—then forward again to solve it—is what gives building envelope design professionals the expertise to avoid those types of errors in the first place. After seeing the same types of detailing mistakes over and over again, building envelope specialists know what to look for, both in contract documents and in the field, to identify and resolve incipient problems.

Field Verification and Testing

Even after building exterior components have been installed, the envelope consultant remains an important part of the project team. Verifying that assemblies perform as designed, and that they are constructed in accordance with the contract documents, is another key role of the building envelope design professional.

In one recent example, a popular hotel casino looked to add a high-rise addition to the existing guest accommodations, to be clad in a unitized glazed curtain wall assembly. With 156 glazed panels per floor and eight floors of curtain wall cladding, the building was set to have nearly 1,250 curtain wall units. Asked to review production and installation of the curtain wall system, our building envelope specialists discovered that fabrication of some of the panels was not dimensionally correct, leading to alignment problems during installation.

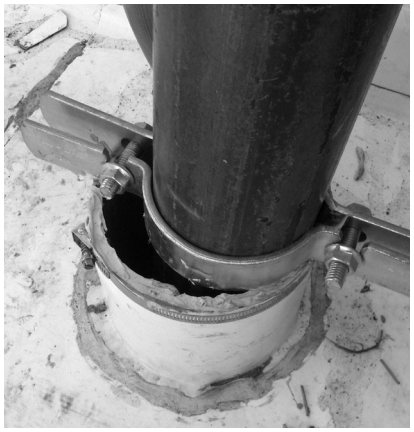
After sending the panels back to be deglazed and reconstructed, the owner positioned a full-time representative at the manufacturing plant, to improve organization and quality control. With the additional oversight of the envelope specialist, not only did product quality improve, but also production volume, rising from 25-30 panels per

day up to 30-40. The increased output permitted the construction team to catch up with the original project schedule, erasing the time lost due to panel defects.

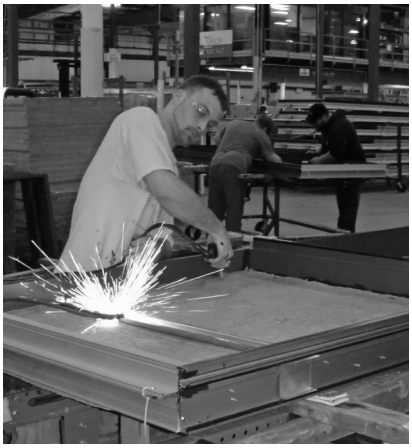
Once the new panels were installed, the building envelope consultant specified and oversaw air and water infiltration field testing to verify performance of the curtain wall system. The testing process involves specifying the relevant protocols as per industry standards—most commonly, those published by the American Society for Testing and Materials (ASTM International) or the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)—identifying appropriate test locations, establishing performance criteria, and observing testing to see that it conforms with the specified test methods.

For units that fail, the envelope consultant analyzes the test results and the relevant building elements to determine the probable cause and to recommend repairs. The modified assembly is then retested to confirm that it fulfills performance criteria.

In our high-rise hotel example, field verification and testing uncovered problems that might not otherwise have been noticeable until symptoms of distress and failure emerged later



An open pipe penetration spotted during a waterproofing consultation.



Fabrication evaluation to verify product quality, as part of a third-party review.

on, at which point fixing them would be much more costly, difficult, and disruptive.

Collaboration

Perhaps most importantly, involving a building envelope consultant in a new construction project frees up the prime architect to focus on design development, without becoming bogged down with the intricacies of waterproofing detailing, component anchorage, air barrier specification, or other technicalities. Rather than expending the designer's time on product comparisons and code research, the client can derive the most value from the prime architect by working with him or her to create a building that satisfies program requirements while achieving a desirable and, ideally, innovative and powerful aesthetic.

Green building designers are already responsible for creative solutions to the problems of energy consumption, resource depletion, and carbon emissions, making it all but impossible to simultaneously achieve fluency in roof wind load code requirements or best practices for face-sealed glazing systems. The services provided by a building envelope consultant are not a duplication of those performed by the architect of record; they supplement the design services that are common practice for a new construction project. Although it is not required that an architect provide details for every single roof termination, for example, it is enormously helpful in taking the guesswork out of installing the roof. The building envelope consultant fills in the gaps to help the construction process run as smoothly as possible.

To make the most of an exterior envelope consultant, it's best to involve him or her early in the design phase, before construction has begun. That way, the envelope specialist can raise questions and identify potential problems while there is still ample time to correct them. With everything sorted out ahead of time, construction delays may be less likely, saving money for the property owner and avoiding conflict on the project team.

During construction, the envelope consultant should be available to review shop drawings and submittals and to observe construction, identifying and responding to incorrect installation, poor workmanship, or unforeseen issues promptly. Once systems have been installed, the envelope specialist can specify and oversee functional performance testing, such as air and water infiltration tests, to correct deficiencies that would otherwise result in leaks and premature deterioration.

The Big Picture

Today's building systems are complex, and technical requirements are even more so. To adapt, project teams have become more and more specialized, with separate installers responsible for each proprietary assembly. Add to that the involvement of independent consultants for mechanical, electrical, plumbing (MEP), structural engineering, amenities, lighting, furnishing,

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representative projects

New Construction Consultation and Peer Review

As building enclosure experts, Hoffmann Architects' design professionals not only diagnose and resolve distress in existing buildings; we also provide consultation and review services for new construction. With focused attention to building envelope performance, we develop design details, review drawings and specifications, evaluate weather integrity and energy performance, and provide options for code-compliant envelope assemblies.

Recent new construction consultation projects include:

University of Connecticut Health Center, Ambulatory Care Center
Farmington, Connecticut
Consultation and Construction Review

Seneca Allegany Casino & Hotel
Salamanca, New York
Curtain Wall Design and Installation Review

American University Kogod School of Business in Washington, District of Columbia. *Peer Review Design Consultation for New Addition.*

Smithsonian Institution, National Museum of the American Indian
Washington, District of Columbia
Roofing and Waterproofing Consultation

University of Virginia Special Collections Library
Charlottesville, Virginia
Waterproofing Design Consultation

Yale-New Haven Hospital Clinical Laboratory, 55 Park Street
New Haven, Connecticut
Building Envelope Consultation

The Cleveland Clinic InterContinental Hotel
Cleveland, Ohio
Waterproofing Design Consultation

The Jefferson Library
Charlottesville, Virginia
Waterproofing Consultation and Document Review

Yale University Loria Center for the History of Art
New Haven, Connecticut
Building Envelope Consultation and Peer Review

2230 Broadway
New York, New York
Building Envelope Consultation and Peer Review

Middlesex County Courthouse
Saluda, Virginia
Waterproofing Design and Contract Document Review

East Rock Magnet School
New Haven, Connecticut
Building Envelope Design Consultation

The Larstrand at 2182 Broadway in New York, New York. *Building Envelope Consultation and Peer Review.*

Office Building, 2021 L Street NW
Washington, District of Columbia
Waterproofing Design Review

Reston Bible Church
Loudoun County, Virginia
Third Party Peer Review

Connecticut Army National Guard Regional Training Institute
Niantic, Connecticut
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sustainable design, renewable energy, urban planning, building codes, accessibility, etc., and it seems as though one more consultant is the very last thing a project team needs. But the role of the building envelope consultant is not to look at one system in isolation; it's to make sure that the exterior envelope—in consort with the mechanical and energy packages—works together as a whole.

True, the value in an exterior envelope specialist may be found in the details, but it also lies in bringing together the disparate systems that comprise the building's exterior shell. The most critical role a building envelope consultant performs for any project, whether new construction or rehabilitation, is to make sure the building envelope performs as intended, and performs well. ■

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